SECTION 7.2 COUNTY-SPECIFIC VEHICLE AGE DISTRIBUTION AND POPULATION MATRICES

This section describes the methodology used in developing refined vehicle age distribution matrices to be used in EMFAC2000. Accurate estimates of vehicle population are necessary for calculating ton per day emission estimates for exhaust and evaporative emissions while vehicle age distributions are important for calculating reliable average fleet emission factors.

7.2.1 Introduction

Compared to the previous statewide model year distributions, the EMFAC2000 age distributions have been resolved to the sub-county level. Another feature of the revised age distribution matrices is their resolution by fuel type and registration status. In addition, age distributions for calendar years 1997 and 1998 have been developed, forming the basis for empirically derived vehicle population growth rates.

In MVEI7G, statewide vehicle model year distributions were developed for the following seven vehicle classes: Light Duty Automobiles (LDA), Light Duty Trucks (LDT), Medium Duty Trucks (MDT), Heavy Duty Gasoline Trucks (HDGT), Heavy Duty Diesel Trucks (HDDT), Urban Diesel Transit Buses (UBD), and Motorcycles (MCY). A number of data sources were used in developing these model year distributions. In general, LDA distributions for calendar years 1978 through 1991 were based on annual Department of Motor Vehicle (DMV) year-first-sold reports but were projected for calendar years 1992 through 2005 based on calculated yearly retention rates. All of the truck class distributions were based on calendar year 1970 through 1975 Polk truck reports. UBD and MCY model year distributions were derived from DMV data and a 1975 Gallup report, respectively.

7.2.2 Methodology

For EMFAC2000, vehicle age distribution matrices were developed for calendar years 1997 and 1998 for the thirteen vehicle classes shown in Table 7.2-1, two fuel types, and 69 counties and sub-counties, and for vehicle ages ranging from 1 to 45 years. The thirteen vehicle classes were differentiated primarily on the basis of gross vehicle weight, as shown in Table 7.2-1.

Specific steps involved in development of the refined vehicle age distribution matrices are detailed in Steps (1) through (6) below and shown in the accompanying flowchart (Figure 7.2-1).

(1) The EMFAC2000 vehicle age distributions were developed based on analysis of approximately 30 million DMV vehicle registration records provided by the California Energy Commission (CEC) for calendar years 1997 through 1999. Although the DMV registration data was obtained for calendar years 1995 and 1996, it was not included in the analysis because the data sets were missing vehicles where the registration paperwork was in the process of being completed

(e.g. missing smog check certificates, proof of insurance, etc.). These missing vehicles were not counted in previous versions of EMFAC.

The registration databases used were generated by the DMV for the CEC on an annual basis, generally in the fall or summer of each calendar year. As such, the vehicle age distributions developed by the MVAB represent snapshots of the vehicle fleet at those particular times.

Table 7.2-1. Weights of vehicle classes used in EMFAC2000.

Vehicle Class	Code	Description	Vehicle Weight (lbs.)
1	PC	Passenger cars	ALL
2	T1	Light-duty trucks	0 - 3,750
3	T2	Light-duty trucks	3,751 - 5,750
4	T3	Medium-duty trucks	5,751 - 8,500
5	T4	Light-heavy duty trucks	8,501 - 10,000
6	T5	Light-heavy duty trucks	10,001 - 14,000
7	T6	Medium-heavy duty trucks	14,001 – 33,000
8	T7	Heavy-heavy duty trucks	33,001 – 60,000
9	T8	Line-haul trucks	60,000 +
10	UB	Urban buses	ALL
11	MC	Motorcycles	ALL
12	SB	School buses	ALL
13	MH	Motor homes	ALL

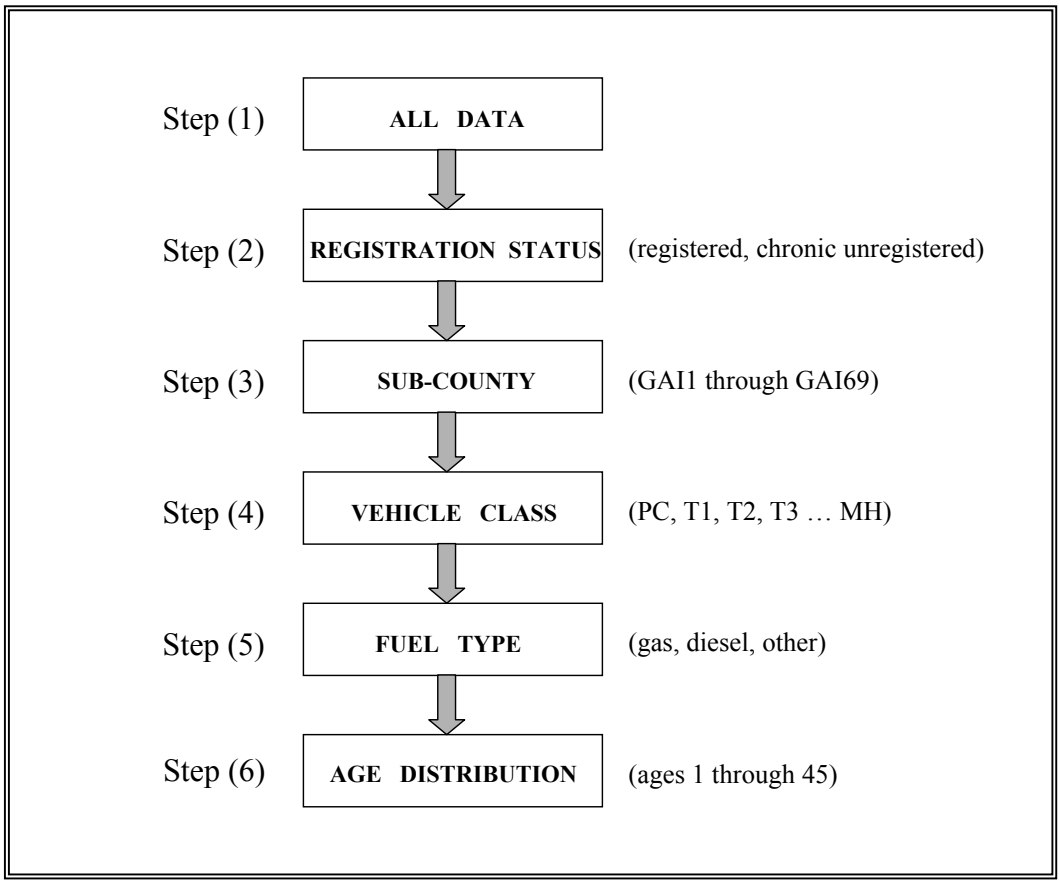
The original CEC/DMV registration database includes 55 fields for each of the approximately 30 million records. A program was written which extracted only those fields necessary for development of the vehicle age distributions. Duplicate fields were obtained for some of the parameters (fuel type, body style, and vehicle weight) in the DMV database because the data came from a variety of sources (e.g. DMV Master File, VINA decoder software). In general, the fields derived from the VINA software ('Fuel Type', 'Body Style') were used because the DMV Master File reporting rate was often poor. The Master File-derived fields ('Motive Power', 'Body Type Model') were used in those cases where VINA-derived data were not available.

(2) Based on the DMV registration expiration date field, vehicles were classified either as registered, instantaneously unregistered, or chronically unregistered. Registered vehicles were assumed to include all currently registered vehicles. The registration status for instantaneously unregistered vehicles (those vehicles which have been unregistered for less than two years) was reevaluated using DMV data from a subsequent calendar year. If the registration status changed and became current within that time period, then the vehicle was counted as current. Chronic unregistered vehicles were assumed to be those vehicles which have been unregistered for two years or more. This distinction is made in the model to

adjust for the assumption that chronically unregistered vehicles do not benefit from periodic smog check.

Table 7.2-2 summarizes the registration status of vehicles by vehicle class based on analysis of DMV data for calendar year 1997. This table shows that the percent of registered vehicles varies between approximately 90.6% and 98.9%, depending upon the vehicle class, while the percent of unregistered vehicles ranges between 1.1% and 9.4%. Based on these data, for calendar year 1997, approximately 92.7% of all vehicles in California were registered, while 7.3% were instantaneously unregistered. The fraction of instantaneously unregistered vehicles that registered within two years was subsequently considered registered, while the fraction that did not re-register was considered chronically unregistered.

Figure 7.2-1. Flowchart showing steps involved in development of vehicle age distribution matrices for EMFAC2000.



To validate the accuracy of the DMV registration rates, field surveys of automobile registration status were conducted in Southern California shopping

mall parking lots in 1991.[1] These surveys suggest that almost 92% of light duty passenger cars were registered while only 7.8% and 0.56%, respectively, were instantaneously and chronically unregistered. These "real world" registered and instantaneously unregistered rates are very comparable to the DMV registration rates for light duty passenger cars. As field surveys of the registration status of other vehicle classes (T1 and above) have not yet been conducted, it is not possible to validate the DMV-estimated registration rates for those classes.

The chronically unregistered vehicle fraction could not be accurately evaluated using the DMV registration data. Based on discussions with DMV staff, it was decided that the discrepancies between field and DMV chronically unregistered registration rates for light duty passenger cars were attributable to: 1) the DMV not purging the records of those vehicles which move out of state; 2) individuals not informing DMV of vehicles which have been junked; and 3) individuals failing to notify DMV of vehicles which have become non-operational.

Table 7.2-2. Registration status for 1997 calendar year vehicles by vehicle class based on DMV registration records.

Calendar Year	Code	% Registered	% Instantaneously Unregistered	Chronically Unregistered
1997	PC	92.0	7.44	0.56
	T1	92.0	7.44	0.56
	T2	93.1	6.34	0.56
	T3	93.1	6.34	0.56
	T4	91.7	7.74	0.56
	T5	94.1	5.34	0.56
	T6	93.2	6.24	0.56
	T7	92.6	6.84	0.56
	UB	98.4	1.04	0.56
	SB	96.1	3.34	0.56
	MC	90.1	9.34	0.56
	MH	92.5	6.94	0.56
	All Classes	92.7	6.74	0.56

For EMFAC2000, the DMV-inferred numbers of registered and instantaneously unregistered vehicles were used directly, given their reasonable agreement with field survey results, while the number of DMV-inferred chronically unregistered vehicles was adjusted to more closely approximate the field survey rate for light

1 Dulla, R.D., Horie, Y., and S. Sidawi (1991), Unregistered Vehicle Study Field Survey and Analysis. Report prepared for the California Air Resources Board (Contract No. A866-163) by Sierra Research, Sacramento, CA.

duty passenger cars (0.56%). This adjustment was performed for each vehicle class using the following series of equations:

$$CNCU_{class} = [UNCU_{class}][AF] \quad (7.2\text{-}1)$$

where $CNCU_{class}$ = corrected number of chronic unregistered vehicles for given vehicle class
$UNCU_{class}$ = uncorrected number of chronic unregistered vehicles for given vehicle class
AF = chronic unregistered vehicle adjustment factor

$$AF = [SPCU_{class}/DPCU_{class}] \quad (7.2\text{-}2)$$

where $SPCU_{class}$ = % of chronic unregistered vehicles from field surveys (0.56%)
$DPCU_{class}$ = % of chronic unregistered vehicles for given class from DMV registration database

Given that field surveys of only light duty passenger cars have been conducted to date, we assumed the same field survey chronic unregistration rate of 0.56% for all vehicle classes. It should also be noted that field surveys of chronic unregistration rates have, to date, been performed only in Southern California but were assumed, for this analysis, to apply statewide.

(3) As some counties (e.g. San Bernardino) fall within several air basins, it was necessary to resolve the EMFAC2000 vehicle age distributions to a sub-county or Global Area Index (GAI) spatial resolution (see Section 3.3 for GAI definitions). Vehicles were assigned to one of the 69 GAI based on their county and ZIP code of registration

(4) Vehicles were binned into the thirteen vehicle classes shown in Table 7.2-1 based on the 'GVW Code' and 'Body Style' fields. It was originally intended to use the 'Manufacturers Base and Shipping Weight' field to bin vehicles because the weight is reported to the nearest pound, thus nominally ensuring proper classification of vehicles. However, comparison of a sample of the values reported in the 'Manufacturers Base and Shipping Weight' field with weights published in vehicle certification reports showed a discrepancy, suggesting the VINA software was incorrectly decoding the vehicle weights. As values for the 'GVW Code' field consistently agreed with weights shown in vehicle certification reports, the 'GVW Code' field was used as the main parameter for binning vehicles.

Not all of the vehicles could be assigned to vehicle classes based solely on the 'GVW Code' field. A number of the EMFAC2000 vehicle classes (T1 and T2, T3 and T4, T7 and T8) have the same 'GVW Code' value and therefore needed to be disaggregated using other parameters. As T1 and T2 vehicles could not be differentiated based on 'GVW Code' and 'Body Style', they were disaggregated using reported 1986 through 1994 calendar year production numbers. Due to limited availability of production number data, for 1985 and earlier model year vehicles, 1986 model year T1/T2 splits were assumed, while for 1997 and 1998 model year vehicles, 1996 model year T1/T2 splits were applied. To disaggregate T3 and T4 vehicles, vehicles with Pickup, Van, or Sport Utility 'Body Styles' were assumed to be T3s while all other vehicles with the same 'GVW Code' were assumed to be T4s. All vehicles falling in the T7-T8 weight range (33,001-60,000+ lb) category were assumed to be T7s as there was no other parameter with which to disaggregate these vehicles. The T8 age distribution matrix provided in the current EMFAC2000 output is therefore empty and serves as a placeholder until such time as it is possible to disaggregate the T7 and T8 weight classes.

Vehicles with a "Bus" 'Body Style' were assigned to the Urban Bus (UB) and School Bus (SB) vehicle classes based on key words found in the 'Owner Name' field. For example, vehicles with the key word "transit" were assigned to the Urban Bus class while vehicles with the key word "university" were assigned to the School Bus category. Although it was possible to disaggregate church buses using key words, for EMFAC2000 these vehicles were assigned to the School Bus class. Vehicles with "Bus" 'Body Styles' that did not contain Urban Bus or School Bus key words were assigned to vehicle classes based on their 'GVW Code' field.

As 'GVW Codes' are nominally provided only for trucks, vehicles with missing 'GVW Codes' were generally assigned to the Passenger Car (PC) bin. However, those vehicles with missing GVW Codes and Body Style values not characteristic of PCs were assigned to one or more of the truck classes. These vehicles were assigned to the appropriate weight classes using a weighting distribution developed for those trucks for which both GVW Code and Body Style were reported.

(5) Based on the Fuel Type field, vehicles were binned into one of following three fuel types: 'gasoline', 'diesel', 'electric', and 'other' (flex fuel, propane, and natural gas). Only gasoline, diesel fuel and electric populations were used in the final analysis.

(6) Two vehicle age distribution matrices were developed as inputs to EMFAC2000: one for registered and instantaneously unregistered vehicles and another for chronically unregistered vehicles. The matrices, whose format is shown in Table 7.2-4, provide the number of vehicles ranging in age from 1 to 45 years for each of the 69 GAI, 58 counties, 13 vehicle classes, 3 calendar years, and 2 fuel types.

Table 7.2-3. Format of EMFAC2000 vehicle age distribution matrices.

AGE	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18
	19	20	21	22	23	24	25	26	27
	28	29	30	31	32	33	34	35	36
	37	38	39	40	41	42	43	44	45

e.g. GAI=1, county=2, vehicle class=1, calendar year=1995, fuel type=G

6,	9,	16,	19,	23,	20,	30,	32,	38,
36,	24,	32,	19,	21,	17,	18,	18,	19,
16,	15,	6,	11,	10,	11,	8,	10,	10,
8,	8,	14,	7,	10,	5,	2,	2,	2,
12,	0,	0,	0,	0,	0,	0,	0,	0,

GAI=1, county=2, vehicle class=1, calendar year=1996, fuel type=G

19,	26,	12,	16,	22,	23,	28,	30,	31,
41,	33,	28,	40,	19,	17,	13,	16,	17,
23,	14,	15,	5,	11,	11,	12,	9,	13,
7,	12,	8,	14,	10,	9,	5,	3,	2,
2,	11,	0,	0,	0,	0,	0,	0,	0,

etc…..